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# COMPOSITE COLUMN OR BEAM FRAMING MEMBERS FOR BUILDING CONSTRUCTION

## Related Application

This application claims priority of United States Provisional Patent Application 60/225,337 filed August 15, 2000, and is incorporated herein by reference.

## Background of the Invention

### Field of the Invention

The present invention is directed to composite column or beam framing members for use in building construction. More particularly, the present invention is directed to a composite column or beam and a method for its manufacture that has superior insulating and fire/heat resistance characteristics.

### Reference to Related Art

It is well known that the steel beams and columns that are used as the structural framework of modern buildings are not fireproof. Indeed, when exposed to heat and fire, steel beams and columns will expand, warp and rapidly lose strength. To protect against this type of extreme structural damage as well as the ongoing effects of weather, modern building codes often require that a coating of protective material be applied to the exterior surface of a building's steel framework. These protective materials are typically classified as either fire-resistant materials (i.e. mineral wool, fiberglass or the like) or heat sink materials (e.g. gypsum board, cement plasters, sand, gravel or concrete). However, additional types of thermal or weather insulation may also be thought of as protective materials. Either class of fire-protective material

can, for a reasonable period of time (e.g., one to three hours), be designed to delay the heat from a fire from affecting the steel framework.

Reinforced concrete framing systems, either pour-in-place or precast/prefabricated systems, do offer some known advantages over steel framing systems in the area of fire protection. However, columns and beams constructed of reinforced concrete have the notable disadvantage of being larger and heavier than steel framing members with the same capacity. Additionally, reinforced concrete systems necessarily require the builder to use concrete forms as part of the construction process. The erection, installation and removal of those forms can add significant cost (in time and labor) to any construction project.

Composite beam and column framing members that combine steel and concrete represent a compromise between pure steel or concrete building framing systems and are known in the art. One example is U.S. Patent No. 4,333,285, which discloses a concrete column encased in a unitary steel tube. The column is adapted to support a reinforced concrete beam that is sheathed in a steel shell.

U.S. Patent No. 4,409,764 discusses the use of steel column and beam forms that include internal metal reinforcing skeletons. The forms are prepared at an off-site factory and subsequently erected at the building site. The steel forms are filled with concrete at the building site and remain in place as a permanent part of the building framework.

Finally, U.S. Patent No. 5,678,375 discusses a building framework that includes a number of structural steel members that each has a hollow interior. The steel members have openings that permit the hollow interiors to be filled with concrete in conjunction with the construction of the building frame.

Composite columns and beams are generally stronger than concrete framing members of similar size and are lighter than steel framing members. However, composite framing members still suffer from an increased risk of damage as a result of exposure to heat and flame. Therefore, it would be beneficial to provide improved composite column and beam framing members that have superior insulating, thermal and/or fire resistance characteristics.

**Summary of the Invention**

The present invention is directed to a composite column or beam framing member for use in building construction and a method of manufacturing the column or beam. Preferably, the composite framing member includes a pair of elongated shell members that have a length dimension that is greater than a width dimension. Each shell has one substantially open side that extends along the length of the shell and provides access to an interior channel that is defined by the walls of the shell. The shells are securable to each other along their open sides such that the interior channels of the shells cooperate to define a structural member having an interior volume.

Prior to being secured together, reinforcing bars are positioned throughout the interior channel as required by the user. Spacers or risers may also be positioned along the surface of the interior channel in order to maintain

the reinforcing bars a predetermined distance from the interior surface of the channel. Additionally, the interior channel of at least one of the shell members is coated with protective materials (i.e., insulation). The use of a protective material is most preferred when at least a portion of framing members of the present invention are exposed to the exterior of a building. Under such conditions, the use of a protective material on the internal surface(s) of the framing member (particularly those having exposed external surfaces) provides the framing member with an additional defense against condensation, corrosion, fire and heat.

Preferably, the composite structural member is erected (in the case of a column) or positioned (in the case of a beam) at the work site and filled with a filler material (such as concrete, sand, gravel or the like) according to the needs or requirements of the user.

A preferred method for constructing the composite framing members of the present invention includes a first step of providing a first and a second shell member. Each shell is elongated so as to have a length dimension that is greater than a width dimension and includes one substantially open side extending along the length dimension. The shells are preferably U- or L-shaped such that the walls of each shell define an interior channel.

In a second step, at least one reinforcing member (e.g., a steel reinforcing rod) is positioned within the interior channel of each shell.

In a third step, the first and second shells are secured together at least partially along their respective substantially open sides so that the interior

channels of the first and second shell members cooperate to define either a hollow column or open beam having an interior volume.

In a fourth step, the interior volume of the column or beam is filled with a filler material (e.g., concrete).

In an additional step, a protective material (i.e., thermal/weather insulation) is applied into the interior channel of at least one of the shells following the insertion of the at least one reinforcing member into the interior channel of each shell.

Therefore, the framing members of the present invention include reinforced concrete columns and beams surrounded by steel shells. The shells impart greater structural strength and integrity than the reinforced concrete columns and beams could alone. Furthermore, the concrete core of the framing member, which is aided by the use of a coating of protective material, functions as a heat sink, absorbing heat and allowing the entire framing member a longer structural life than it would have if the steel or concrete were used alone.

**Brief Description of the Drawings**

The invention will now be described in more detail with reference being made to the accompanying drawings in which:

Figure 1 is a perspective view of a preferred embodiment of the composite column or beam framing members constructed in accordance with the present invention;

Figure 2 is a planar end view of a shell for use in constructing a column in accordance with the present invention;

Figure 3 is a planar end view of a column according to a preferred embodiment of the present invention;

Figure 4 is a planar end view of a shell for use in constructing a beam in accordance with the present invention;

Figure 5 is a planar end view of a beam according to a preferred embodiment of the present invention;

Figure 6 is a planar end view of a shell for use in constructing a beam in accordance with an alternative embodiment of the present invention;

Figure 7 is a planar end view of a beam according to an alternative embodiment of the present invention; and

Figure 8 is a diagrammatic view of a method for manufacturing a composite framing member in accordance with the present invention.

**Detailed Description of the Preferred Embodiments**

Referring now to Figure 1, there is shown in accordance with the present invention, a composite column and beam framing member system 10 for use in building construction. The framing system 10 includes column 12 and beam 14 framing members. Preferably, the column 12 has a first 16 and a second 18 elongated shell that each have a generally U-shaped appearance. The beam 14 includes a first 20 and a second 22 elongated shell that each have a generally L-shaped appearance. At least one reinforcing member 24 is secured within an interior of each shell 16, 18, 20, 22. A coating of protective material 26 is also applied on the interior surface of at least one of the shells 16, 18, 20, 22. The shells 16, 18, 20, 22 are preferably secured together and

filled with a filler material 23 to form the column 12 and beam 14 structures of the present invention.

Referring now to Figures 1, 2 and 3, there is shown a column 12 constructed in accordance with the present invention. Preferably, the column 12 of the present invention includes a first 16 and a second 18 elongated shell member. Each shell member includes a base portion 30 and a pair of sidewalls 32, 34 that combine to provide the shells 16, 18 with a generally U-shaped appearance and form an interior channel 36. Flanges 38 extend inwardly toward the channel 36 from each sidewall 32, 34 and, as discussed below, are used in securing the shells 16, 18 together. Preferably, the shells are constructed of steel. However, it will be appreciated that other materials such as metal alloys or other known construction materials may also be used.

Still referring to Figures 1, 2 and 3, at least one reinforcing member 24 is secured within the interior channels 36 of each shell 16, 18. Preferably, the reinforcing member 24 is a steel reinforcing rod such as an angle ("L's"), channel ("U's"), or the like. The reinforcing member 24 is preferably welded onto the base 30 of each shell 16, 18. Alternatively, the reinforcing members may be secured or positioned upon a spacer 40 that is secured to the base 30 and extends upwardly from the base 30 a predetermined distance.

Following installation of the at least one reinforcing member 24, a coating of protective material 26 is applied to the surface 37 of the interior channel 36 of at least one of the shells 16, 18. The use of a protective material is most preferred when at least a portion of framing members of the present

invention are exposed to the exterior of a building. Under such conditions, the use of a protective material on the internal surface(s) of the framing member (particularly those having exposed external surfaces) provides the framing member with an additional defense against condensation, corrosion, fire and heat.

Preferably, the protective material 26 is a known insulation material, such as weather insulation, a fire-resistant material (e.g., mineral wool or fiberglass), a heat sink material (e.g., gypsum board, cement plasters, sand, gravel or concrete) or other type of thermal insulation material. Notably, coating the surface 37 of the interior channel 36 of at least one of the shells 16, 18 with the protective material 26 during the fabrication of the column 12 removes or limits the need to apply insulation to the column 12 in the field and provides the column 12 with superior insulative or fire/heat resistance characteristics.

Still referring to Figures 1, 2 and 3, preferably, the shells 16, 18 are secured together along their respective flanges 38 by welding or similar process. Securing of the shells along the open sides of the interior channel 36 provides the column 12 with a generally open, or hollow, interior that defines an interior volume 39. Following erection of the column 12 at a construction site, the interior volume 39 is filled with a filler material 23 that provides increased structural characteristics to the column. Preferably, the filler material 23 is concrete. However, other types of filler materials 23 such as sand, gravel or aggregate materials may also be used according to the needs of the user.

Referring now to Figures 1, 4 and 5, there is shown a beam 14 framing member constructed in accordance with the present invention. Preferably, the beam 14 includes a first 20 and a second shell 22 member. Each shell 20, 22 has a generally L-shaped appearance that is defined by a base 50 having a first flange 52 that extends upwardly from the base 50 and a sidewall 54 having a flange 56 that extends inwardly from the sidewall 54. The base 50 and sidewall 54 of each shell 20, 22 form an interior channel 59. Similar to the column 12 discussed above, at least one reinforcing member 24 is secured to the interior surface 60 of the interior channel 59 of each shell 20, 22. Thereafter, a coating of protective material 26 (as discussed above) is applied to the interior surface 60 of at least one of the shells 20, 22. The shells 20, 22 of the beam 14 are preferably secured together by welding the flanges 56 of the sidewalls 54 of the shells 20, 22.

Welding of the shells 20, 22 provides an elongated beam 14 framing member having a generally U-shaped appearance having an open interior defining an interior volume 62 that is accessible though an open side 64. Following erection of the beam 14 at a construction site, the interior volume 62 of the beam 14 is filled with a filler material 23 (as discussed above) that provides increased structural characteristics to the beam 14.

Referring now to Figures 6 and 7, there is shown an alternative embodiment of a beam 14' framing member constructed in accordance with the present invention. Preferably, the beam 14' includes a first 20' and a second shell 22' member. Each shell 20', 22' has a generally L-shaped appearance

that is defined by a base 70, 71 having a first flange 72 that extends upwardly from the base 70 and a sidewall 74 having a flange 76 that extends inwardly from the sidewall 78. The base 70 and sidewall 74 of each shell 20', 22' form an interior channel 77. The base 70 of the first shell 20' is preferably wider than the base 71 of the second shell 22' such that a floor or roof system 110 may be adapted to abut against the first shell 70 while being supported by the beam 14'.

At least one reinforcing member 24 is secured to the surface 79 of the base 70 of each shell 20', 22'. Alternatively, spacers 40 are provided along the surface 78 of at least one shell 20', 22' to support the span of the at least one reinforcing member 24 from one shell 20' to the other shell 22'. Following insertion of the reinforcing member 24, a coating of protective material 26 (as discussed above) is applied to the interior surface at least one of the shells 20', 22'. The shells 20', 22' of the beam 14' are then preferably secured by welding together the flanges 76 of the sidewalls 74 of the shells 20', 22'.

Welding of the shells 20', 22' provides an elongated beam 14' framing member having a generally U-shaped appearance having an open interior defining an interior volume 82 that is accessible though an open side 84. Following erection of the beam 14' at a construction site, the interior volume 82 of the beam 14' is filled with a filler material 23 (as discussed above) that provides increased structural characteristics to the beam 14'.

Referring now to Figure 8, there is shown a method 90 for constructing a framing member in accordance with the present invention. Preferably, the

method for construction includes a first step 92 of providing a first and a second shell member, each shell being elongated so as to have a length dimension that is greater than a width dimension and including one substantially open side extending along said length dimension. Additionally, the walls of the shells preferably provide the shells with a generally U- or L-shape and define an interior channel in each shell.

In a second step 94, at least one reinforcing member (e.g., a steel reinforcing rod such as an angle ("L's"), channel ("U's") or the like) is positioned within the interior channel of each shell.

In a third step 96, a protective material is applied into the interior channel of each shell. As discussed above, the protective material 26 is preferably a known insulation material, such as weather insulation material, a fire-resistant material (e.g., mineral wool or fiberglass), a heat sink material (e.g., gypsum board, cement plasters, sand, gravel or concrete) or other type of thermal insulation material.

In a fourth step 98, the first and second shells are secured together at least partially along their respective substantially open sides so that the interior channels of the first and second shell members cooperate to define a hollow column or open beam having an interior volume.

In a fifth step 100, the interior volume of the column or beam is filled with a filler material (e.g., concrete).

Therefore, by the present invention there is provided composite column and beam frame members for use in building structures that combine the

characteristics of steel and reinforced concrete with superior fire-resistant qualities. However, having discussed several embodiments of the present invention, various modifications thereof will be apparent to those skilled in the art and, accordingly, the scope of the present invention should be defined only by the appended claims and equivalents thereof.

We claim: